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LINX Network Monitoring
Executive Summary

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An Internet Exchange Point (IXP) is a physical infrastructure that allows different Internet Service Providers to exchange Internet traffic between their autonomous systems by means of mutual peering agreements. Each IXP uses different hardware and software to monitor its network so that the format of network monitoring data is typically unique to one IXP. Consequently, a monitoring tool developed for one IXP and specific to its infrastructure cannot be shared and used by another IXP without major changes. Further, since IXPs develop their own disparate set of tools, each of which has a different method for outputting data, it is quite difficult if not impossible to compare data from different IXPs side by side. The LINX network monitoring project, conducted with the collaboration of the London Internet Exchange Point, a member of the Euro-IX consortium, addresses precisely these problems.

This report describes the design of an entirely new system architecture on which future network monitoring tools can be based so that they can be deployed on IXPs having disparate hardware and software infrastructures. The architecture relies basically on three small, language-independent, modular components: the Glue component retrieves the non-standard data created by the network resource and converts it into a specified standard format, ensuring that IXPs do not have to change their original data representation format; the PoD analyses the data and acts a server, yielding the data to clients upon request; the GUI, acting as a client, is in charge of listing the available PoDs, requesting the data from them and displaying the data graphically in a standard way.

In addition, this report discusses the implementation of a network monitoring toolkit that is based on said system architecture, in addition to a description of the necessary set of standards used to make this inter-IXP compatibility possible. The actual monitoring functionality implemented is based on requirements provided by LINX throughout the course of the project. The toolkit developed consists of five tools or Remote Monitoring Functions (RMFs): RTTvsTime, as its name implies, plots a simple graph of round-trip time versus time and acts as proof of concept for the system architecture; ThresholdRTT bases its analysis on round-trip times and a set of thresholds: when a particular threshold is exceeded the graph displays a bar of a different color so that the network administrator can easily tell when an interface is critical and requires attention; ThresholdRTTRealTime is the real-time version of the previous tool;

LinkStatus uses the program `fping` to query a series of interfaces and performs its analysis based on a set of user-specified thresholds; finally, MinMaxPing also uses `fping` but displays statistical information such as average, maximum outlier and standard deviation on a graph.

Since the client required that the actual monitoring data be encrypted when transmitting it over a public network such as the Internet, SSL with mutual authentication was used to provide confidentiality. The report discusses precisely how this was implemented, as well as the actual protocols used by the entire system. Further, it discusses the development tools and technologies used and the reasons for having selected them; a description of the testing methods used and the actual deployment at LINX of the system developed are also included.

Given that some of the requirements were subject to change and others not clearly defined, the project used the Extreme Programming (XP) software development approach. XP is iterative and emphasizes short development cycles which were fixed to one week in length. While not all the practices outlined by XP were employed mostly due to time constraints, some important ones that were implemented included pair programming, where two people develop at one computer, one coding and the other one checking the code, constant refactoring (essential since client requirements changed fairly often throughout the project) and constant testing. The report discusses these practices as well as the methodology in detail, along with all other project management aspects such as how the team organized itself, the work schedule and risk management.

Moreover, the report includes a section on future work that describes improvements or additions to the system that were not included due to time constraints or because they were out of scope. Some of these consist of a wider deployment of the system on other member IXPs of Euro-IX as well as the addition of new RMFs to make the monitoring toolkit more powerful. Finally, the report contains a user's manual that describes the system requirements, how to install the toolkit and how to run it.

Despite the many challenges encountered along the way, the project has been rewarding and a great success: all team members contributed to developing a product that is not only technically sound but that the Chief Executive Officer of LINX expressed great satisfaction with.